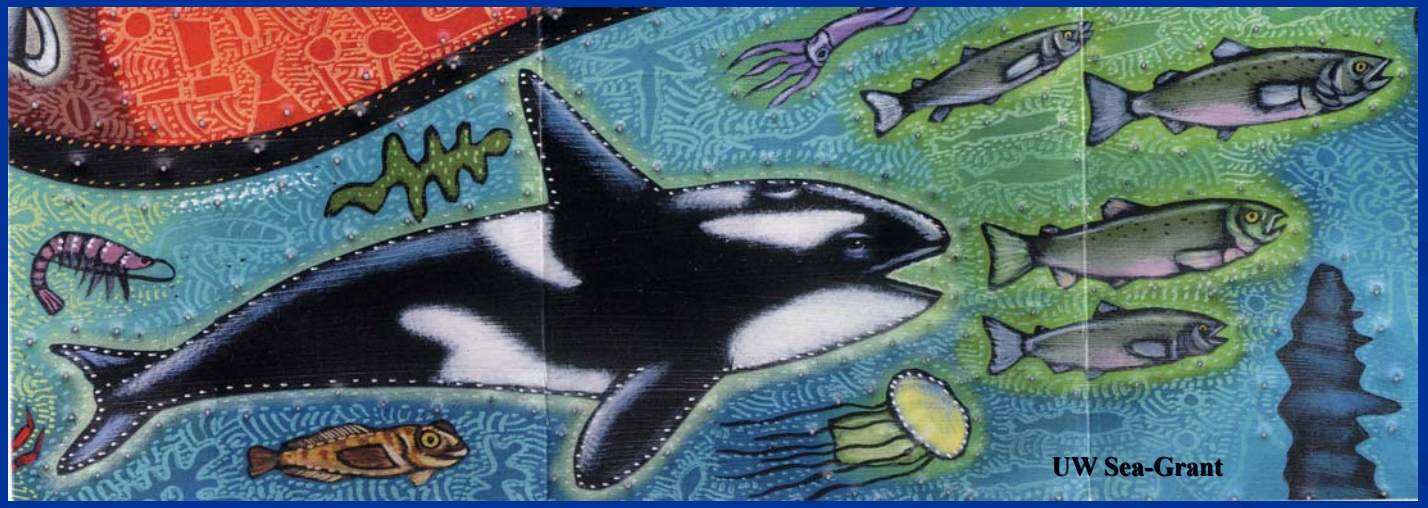
The Changing Landscape of Puget Sound: Has Urbanization Impacted Orcas?



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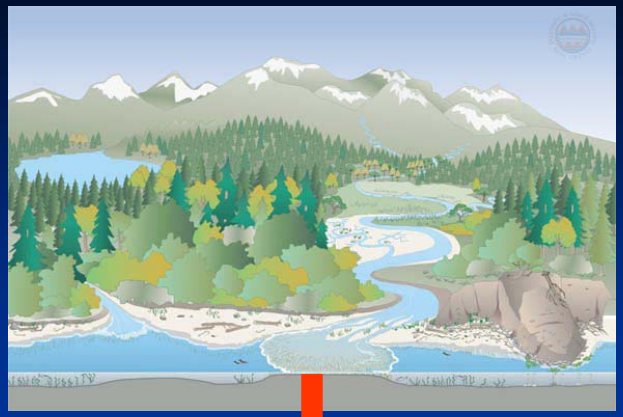
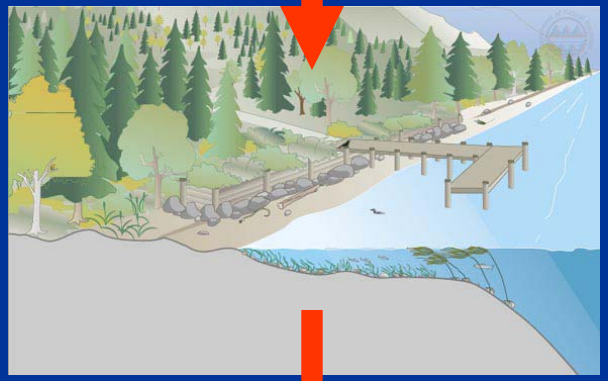
Cumulative Impacts of Watershed Development

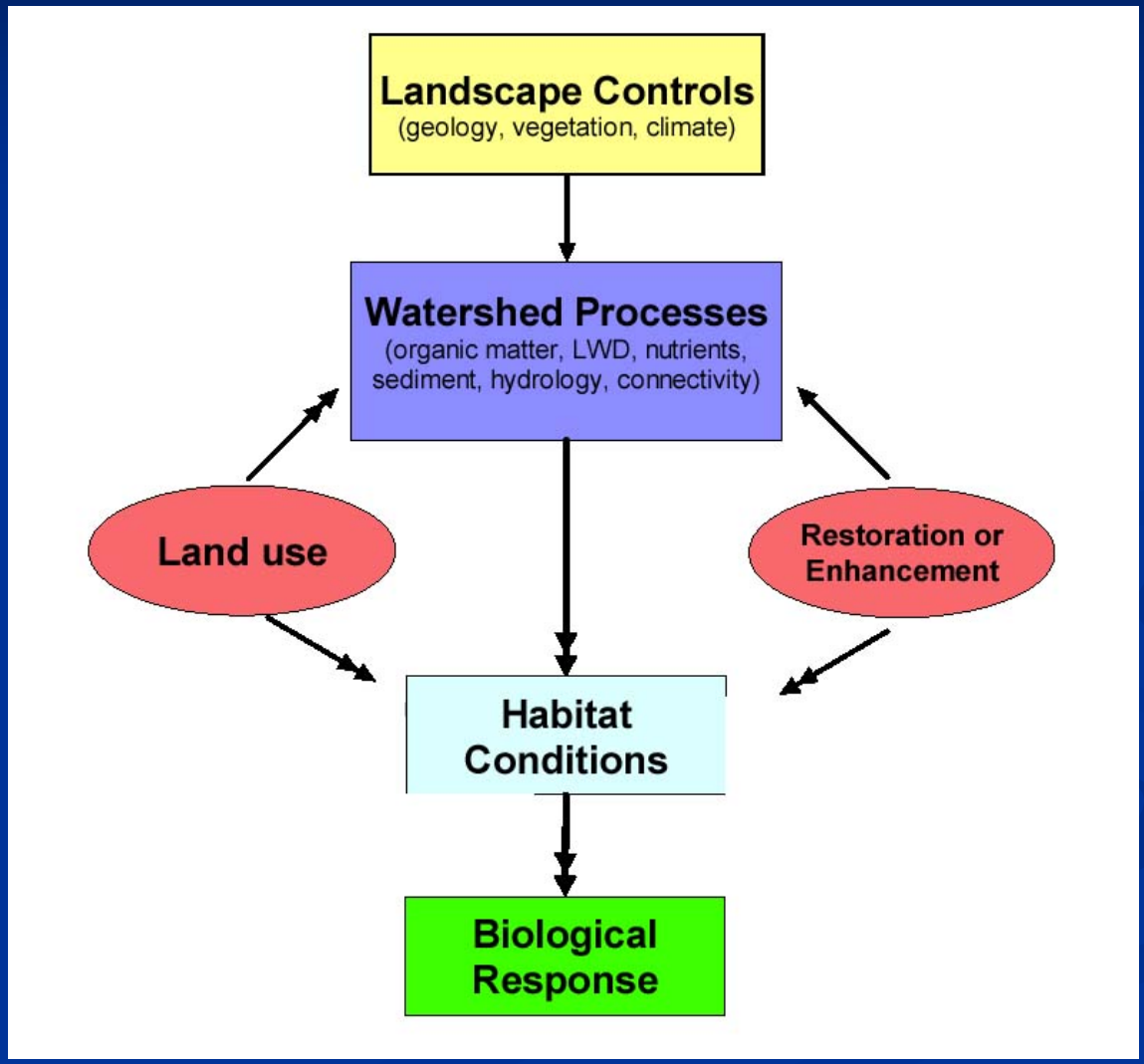
Ecosystem Alterations And Unintended Consequences





The Development Process

Watershed Conceptual Model



Cumulative Impacts Analysis

- Conversion of a forested landscape to a "built" environment dominated by impervious surfaces
- Shift in natural hydrologic regime (one of those unintended consequences)
- Human land-uses are sources of point-source (WWTP) and NPS pollution (urban, industrial, agricultural)
- Stormwater runoff is the primary transport mechanism moving pollutants from the landscape to streams, rivers, and ultimately to Puget Sound

Cumulative Impacts Analysis

- More unintended consequences:
  - Physical Habitat Destruction in the Nearshore
  - Water Quality Degradation
  - Sediment Contamination of Estuaries
- Biological Outcomes:
  - Decline in Aquatic Biodiversity
  - Reduced Abundance of Salmonids
  - Shift in Predator-Prey Relationships
  - Bioaccumulation of Toxic Chemicals in the Food Web

Where and How does Stormwater fit into this puzzle?

Puget Sound Beneficial Uses

- *Fish & Wildlife Habitat*
- *Human Contact Recreation*
  - *Swimming*
  - *Boating*

- *Fishing & Shellfish Harvest*
- *Shoreline Residential Development*
- *Commercial & Industrial Activity*

- *All of these require Clean Water*

Stormwater or NPS Runoff

- **Multiple Sources:**
  - Commercial-Industrial
  - Suburban-Urban
  - Rural-Agricultural
  - Transportation

- **A Mixture of Pollutants:**
  - Land-use Dependent Constituents
  - Metals, Hydrocarbons, Pesticides, Herbicides, & Microbes
  - Typically at Low Concentrations and Localized at Outfalls

- **Most stormwater is not effectively controlled or treated prior to discharge due shortcomings of our mitigation-based SWM strategy**

Stormwater or NPS Runoff

- Degraded Water Quality and Impaired Beneficial Uses (CWA 303(d) Listings)
- Salmonid Mortality (both juveniles & pre-spawn adults)
- Long-term, cumulative impacts are largely unknown
- No known impacts on Orcas, but few studies have addressed this pollutant source

Management Implications

- Enhanced wastewater & CSO treatment.
- Source control is key! Pollution identification & correction (PIC) programs can be very effective if implemented on a watershed scale with active stakeholder involvement (education).
- Stormwater management needs to be protection-based (not mitigation) and more widely applied (BMP retrofits).
- Low impact development practices, and innovative watershed management have the potential to reduce or eliminate NPS pollution.

Thank You!!!

Questions???